

This is Your Brain on Music: The Study of Musical Influence on the Cognitive Mindset
and Learning

by
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This is dedicated to my family who inspired me to keep being myself.

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ABSTRACT

ALLYSA NICOLE LIPSEY: The Study of Musical Influence on the Cognitive Mindset
and Learning

(Under the direction of Roy Thurston)

This thesis examines the use of musical influence on the brain with an emphasis on the effects on cognitive mindset and learning in mathematics education. It explores the idea of the use of different trials and methods to potentially unlock new knowledge about the brain through listening to music during in-class group work, individual work, and class assessments. It allows for an analysis of the music's effect on the brain and creates discussion in multiple classrooms and age groups through the eyes of a participant observer in an ethnographic research scenario. By analyzing behaviors of body language, musical taste and stimulation of the students, I demonstrate that music affects the students' perceptions of their course load, grades and overall attitude in the math courses in which they are participants. With the duration of the research spanning a year, I observed many groups of students, polled thousands on social media, and interviewed multiple administrators that have incorporated music into their daily routine inside and outside of the classroom. Results of the research exemplify that music has an effect on the brain, both positive and negative, but inside the classroom is a special case because of awareness and musical choice when the students' minds are the most focused. With the assistance of colleagues, I was able to construct a musical arrangement to utilize in class by studying what motivates students to work and learn. In conclusion, I decided that the right song can motivate and catalyze the learning process and memorization, but the wrong song can have the opposite effect which is apparent when reviewing grades over a period of time.

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INTRODUCTION

“Learning is dynamic!” as Zull (2002) stated in his book, *The Art of Changing the Brain* in regard to the practice of teaching by exploring the biology of learning, and I could not agree more in regards to my viewpoint of learning in everyday life (Zull). The word choice of the word dynamic emphasizes the importance of the change that occurs not only every day, but rather every hour, minute, and second within our brains. It allows for the strict idea of the concepts of effective learning to be accommodated and modified in order to allow different methods to be exposed to an audience and allow equitable achievement for all students in the classroom. While many believe that it is impossible to find a consistent change within the class that would not create a drastic difference in environment that could overwhelm the students, I believe that teachers are overthinking and overlooking the simplest modifications in the classroom: the creative enrichments. One modification that I could think of involved a creative aspect: music. Music is easily assimilated into daily living and is of universal use for different generations, which can be witnessed everywhere and anywhere. I have prior experiences with music inside and outside of the classroom that have expanded my mind and pushed its limits to broaden my understanding of concepts, but most importantly, mathematical concepts. I believe

that this addition of music into the mathematical classroom can create a dynamic for student learning that is innovative as much as it is beneficial.

This thesis will highlight the uses of music in the classroom and how it affects student learning over an estimated research period of a school year. More generally, I conducted research in three areas: the students, the brain, and the effects of music on the brain. I investigated the students as their student teacher or as a proclaimed educational observer for the University of Mississippi without their knowledge of the research, which reduced the concept of a placebo effect and authenticated the results at the end of the research. The brain, the control center of the body, is the star of this paper, not rather than in a scientific or biological standpoint, but rather in a functional and objective point of view regarding the effects of the outside influences introduced to the brain during research. Overall, this thesis explores educational research in order to develop new ways of studying and teaching to not create “better” ways of facilitation, but rather open the door to create possible diversity with proving that music affects the learning and cognitive mindset of students.

CHAPTER I

GETTING TO KNOW THE STUDENTS

Students and Study Subjects

Before the research could begin, I had to determine who would be the subject or subjects of my studies and research, but I could not determine what would be more interesting: early childhood students or secondary students. I figured that either group would allow for significant results and discoveries that set up a perfect scenario to prove my thesis. So, I chose both. The comparison and contrast between the groups the groups created a dimension of discussion that I could not create with one group's internal dynamics, and that prospect became my deciding factor of conducting research within multiple age groups. Music is such a universal topic that it creates a specific dynamic in deciding to study more than one group of students. Making the decision of researching inside and outside of the same age groups was one of the toughest choices. However, it became also the best decision that I could have made because it covered every thought and idea that I could hypothesize about the study. Each group had its own personalities and behaviors that made this research anything but boring. Without the diversity of the

groups, I do not believe that the study would have been as successful. All groups will be discussed further in more detail below.

The Young Subjects The youngest children involved in the study were within the age range of four to six years old who attend preschool and kindergarten. They were divided into two groups because of their age and class, with the total being around thirty students altogether. They became the most energetic and exciting group because of their willingness to participate and have another teacher in the room. My niece, Alana, was among those of the students that I observed, and she became one of my emphases of focus because of my prior knowledge of her background and family life. Her participation in the study gave a control person for a direct comparison to other participants. She is my sister's daughter, and before her birth I was fascinated with the idea that babies' minds can be manipulated while in the womb. My sister and I would listen to music every day for three to four hours after my sister reached her second trimester, during her labor, and then eventually, during birth. With a musically inclined family and an early musical upbringing, she became a great control subject to compare information gained from other students in her grade at the same age. In addition to her, I focused on other children that did not have a musical background, and to my surprise, there were many students who did not have a heavy influence of music within their family life. To have an accurate juxtaposition to Alana, I found one of her best friends named Chloe; she had no musical upbringing with her parents who claimed to not have any musical talent or skill, but had an appreciation for music when she would get picked

up by her parents from school. All students had a mild proficiency in mathematics, but with them being so young, I was happy to hear valid and coherent sentences regularly.

In order to keep my analysis as controlled as possible, I approached the students as an education observer from The University of Mississippi, so they would be more natural in their environment and would learn to trust me. All of the students were excited to see me and have another teacher in the room, which made the beginning of the research highly anticipated. With boisterous, loud and open-minded attitudes, these students had me ready to learn as much as possible as I teach and prove my ideas, but nothing prepared me for the discoveries uncovered.

The Middle Children This group of students were my largest and most opinionated groups of students when it came to their use of music in their everyday life. With them being in eighth grade and varying between the ages of twelve through fourteen, they are on the edge of young adulthood and are truly discovering themselves away from their parents' ideas and morals. As with the younger subjects, I chose two students to observe closer to compare and contrast with the other age groups.

Caiden and Jordan, both very different from one another in a variety of ways, showed me two different abilities of completing the their tasks of the research because of different circumstances. Caiden became a special case because he is deaf and wears hearing aids, but still finds himself listening to music every day to accomplish small goals like working out, studying, and for entertainment purposes. Jordan does not have the same issue with hearing, but she has a behavioral problem with choices made outside of her will and authority in any capacity. She utilizes music to keep her attitude at a

relative level of calmness in order to work and elevate her mood to play sports and study. Both students understood, to an extent, that music affects their perception of work and task management, and both were beyond proficient in mathematical understanding, but needed assistance with application and finding new methods of focusing on the lessons and classwork.

But as their student teacher for the year, I was able to provide more precision with my research and probe their minds for up to four hours every day where they can be their true selves, outside of their impactful home environment. This specific group totaled at eighty as a whole participating in the research, but each student had their own personality. Even though some of the students had doubts about the influence, all of them agreed that they use music on a daily basis for different parts of their day and lives. This information intrigued me to study this group closely. As exciting as this group made me, they also scared me because of them being in a vulnerable stage of life where they truly do not know what they want except to be adults with their own thoughts. This research became a journey of trial-and-error and self-discovery for this group that lead to immense unearthing of points of interest to discuss.

The High School Subjects Being the most mature of the selected groups, they were confident and committed to their likes and dislikes of music, and its many uses in their everyday lives. They were the more introspective groups of subjects I worked with over the year long process, because they question themselves day to day whether it be with their relationships, education, or futures after high school. Again, I decided to observe a select number of students closely from the large group to intently monitor

progress and determine an appropriate outcome, but unlike the other two groups, I chose three students to watch based on temperament and point of view of learning and music.

Even more diverse than the middle school students, Claire, Hannah, and J.T. could not be more different academically and behavior-wise inside and outside of the classroom. All of them are in Foundations of Algebra with me as their student teacher for the year along with my clinical instructor, so they all started began the class at about the same level of understanding in mathematics. Claire, the mild-tempered student, is the most receptive to influence and change because of her willingness to learn and improve in order to stay in ROTC and advance into Algebra I. She did not pass eighth grade by only a few points and excels in foundations, but has a serious focus issue that involves several kinds of outside factors. She claimed to be a believer in music for working, but not for educational use because of distractions and this intrigued me to pay closer attention to her progress over time. Then, there is J.T., the moderate-tempered student, and he has the second lowest motivation in the class which reflects in his grades. He cannot sit still during a single lesson without tapping his hand, pencil, or feet and occasionally someone's head. He believes that music is a constant algorithm in his life and that he cannot function without it, even in class, and this is what made him stand out to me to become a focus in this research. Finally, there is Hannah, the most hot-tempered student of all three students. She is low achieving and has little motivation to succeed in anything but friendships and out of classroom relationships, because she says that she does not have much support away from school except for music. The messages of the music do not say to get an education, but rather to focus on one's connections and

networking. This captivated me to pursue her thoughts and see how I could potentially alter them to change her idea of music, which could influence her to be lucrative in the math class.

Similar to the middle school groups, I was fortunate to be chosen as one of the two student teachers for their classes which made it easy to monitor their evolution from the first day to the last day of research. This group had a diversity that is unmatched because of the variance of behavioral issues and academic success, and that inspired me to learn and strive for more in order to allow their creativity to be utilized constructively while creating another outlet within the classroom to intrinsically motivate them. Now that all of the participants and what each individual students' contributions to the research has been discussed, research of the brain can be applied to each participant with larger implications.

CHAPTER II

GETTING TO KNOW THE BRAIN

Overview of Function

The brain, unlike personality, is a part of biology that is a natural component of every living being because everyone has a brain. Of course, the functional capability of some brains in comparison to others can be different, but the overall functions and general uses of the brain are similar from person to person. For every person, the brain is about two percent of the total body weight, and is the organ that controls all functions of the body and interprets information from the outside world. The brain is composed of three parts: the cerebrum, cerebellum, and brainstem; it composes the entire CNS, central nervous system (Hines, 2018). This is all fascinating and relevant information, but it is not the focus of the thesis. The focus is on learning and how music affects the brain, but before we can talk about the effects, we must understand the action of learning in the brain. So, to meet that criteria, we must discuss more specified sections of the brain and how it is involved in learning, rather than get too distracted with discussing entire brain.

Notice, I said action when I referred to learning because that is what it is inside of the brain, as well as, outside of the brain. The brain is a constant muscle of growth, knowledge and perception for each person, which means we all have different parts that are utilized more than others, by opinion. According to facts, the cortex determines the ability of higher function. The cortex is the surface area of the brain, and the folding of it increases the brain's surface area which allows for more neurons to fit inside the skull. This part interested me, but the most interesting aspect was the frontal lobe of either hemisphere of the brain because of their functions. The frontal lobe controls personality, behavior, emotions, judgement, planning, problem solving, intelligence, concentration and awareness, which are all areas that affect my research in a positive or negative way (Hines, 2018). This part of the brain processes experiences and determines if it is an experience worth remembering and reinventing for the same emotions and feelings to be invoked. So, these two parts of the brain, generally, will illustrate the knowledge gained from the experience of listening to music inside of the classroom.

The Art of Changing the Brain presents this information:

Up to now we have developed this idea of balance as a practical matter. The structure of the brain teaches us that we should challenge our learners to use both the front and back cortex. If we do not teach to both the back and the front cortex, it is unjust for students. Keeping a just balance is our duty. (Zull, 2002, p. 41)

Along with the cortex and the lobes of the brain, the hippocampus is an important part of how the brain holds memory of music, musical experiences and contexts. It is found in the inner folds of the temporal lobe, and is one of the most studied parts of brain. The hippocampus also houses the hypothalamus, which controls the reaction of the mind with emotions to produce characteristic body feelings as people struggle with problem solving. With problem solving, there is potential stress on the students and the hippocampus is directly affected by stress because its volume will decrease with negative feelings which could affect academic performance and cognition (Dresden, 2017).

Without getting too deep into the biology of the parts of the brain, the biological understanding of cognition and learning that occur in the brain and how that philosophy helps to facilitate students on a different level is still relevant to my research. This section is meant for getting to know the brain and understanding the learning cycle, and that starts with nature of environment in the person in which the brain inhabits. As I read and analyzed books and materials, I found that there is a common understanding that “we provide an unjust education if we do not give every student the max opportunity for learning,” (Zull, 2002) and understanding the brain was just the beginning of the research.

Him Vs Her Brain

Along with understanding the general workings of the brain, I believed that it was important to investigate the supposed differences between the female and male brain in regard to education and perception of knowledge and retention. It is a proclaimed idea that women are “smarter” or “know more” than men, but that is not something I could

allow bias in my research. So, I decided to research it further to prove or disprove the unspoken truth.

Before I could thoroughly focus on the gender-based cognitive mindset, I wanted to know the other preconceived assumptions of the male's mind versus the female's mind. It is believed that women have a brain that is "predominantly hard-wired for empathy," and men possess a brain that is "predominantly hard-wired for understanding and building systems," which is known as the empathizing-systemizing (E-S) theory (Baron, 2004, p. 1). One should remember that the E-S theory does not stereotype, but it gives criterion for people to label an individual person as typical or atypical for their sex. This information allowed me to start to understand the psychological differences of the sexes of my students while I started observing them in class.

While observing my students, I noticed that there are certain strengths that the females have over the males, but the males also have some advantages over the females. There have been some obvious differences with the understanding of the concepts from all of my students, but it lead me in my observations to research history and current studies of the human brain and gender studies.

Hines's (2005) book *Brain Gender* states the following:

Perhaps the greatest amount of information is available on sex differences in cognitive abilities. Most standardized measures of general intelligence show negligible sex differences. However, some subsets that comprise these measures shows small to moderate sex differences. For instance, for the Wechsler

intelligence scales, there is a small-to-moderate sex difference favoring females on the digit symbol/ coding subtest, and there are small sex differences favoring males on the information and block design subtests.

The best known cognitive sex differences [between males and females] may be those on the measures of visuospatial abilities. The largest sex difference favoring males is seen on measures of mental rotations, or the ability to rotate stimuli rapidly and accurately within the mind. (p. 11-12)

This excerpt of information provided me with an idea of what to look for during our units of study before and after the experiment ended in order to put some honesty behind these claims.

Along with the information given in the books, the female and male brains are similar except for the overall size of the brain, which favors men's whose brains are larger and heavier than women's brains. This fact just added more assumption rather than truth of actual relevance of the information because it is a psychological side and not the physical side. In addition to the size of the brain, the age of the brain must also be considered. Even when the concept of age comes into question, no effective studies show any influence of age on cognitive abilities because one cannot expect a young child to achieve the same academic goals as an adult. The studies, also, show that the standardized tests are showing minimal great differences in young children and not any differences in adults' brains, which motivated me into conducting more research.

So, does gender have a significant effect on the brain's cognitive mindset and mathematical learning capabilities? If we are talking from person to person, anyone could say either boys or girls are the smarter sex, but if we are basing everything on research, the books say that gender is just that, gender. Evidence is showing that some cognitive gender differences are growing smaller over time and are refuting any idea of an existence of hormonal influences. Overall, there are fairly small differences from female to male brains, which yield no greater cognitive ability than the other.

What Do We Know in the Present

The brain is such a complicated, ever-changing part of everyone's anatomy that it becomes tiresome to keep up with all the advancements and discoveries that occur on an almost daily basis. However, one should not let the word tiresome cause confusion because this is a fascinating topic of discussion. The aspects of the brain that we know still do not cover all of the structures and capabilities that create properties of flexibility in creative and innovative capacities. One piece of information that all brains possess is schemata (Carruthers, 2010), which is the plural of schema and means the mental structures that an individual uses to organize knowledge and guide cognitive processes and behavior (Michalak, 2014). This is a crucial part of the understanding of the learning aspects of the brain because this is the part research will affect, because it is understood that humans retrieve knowledge from various areas to draw conclusions about missing or non-evidential information from outside sources. The brain's overall functions are genetic and related to nature, but I am focused on the brain's functions as they correspond to nurturing decisions and saved experiences along with behavior.

As said in Jensen's (2008) *Enriching the Brain*:

In short, the human brain is designed to interact with the world and make changes, depending on the quality of interactions. If the interactions are positive and sustained, you'll get one set of changes. If the interactions are negative and intense, you'll get a different set of changes. We change based on our life experiences. (p. 12)

This is what studies suggest about the brain and its relation to learning in the present, and this drove my entire research because this was a constant idea for the effects of the musical influence. Where brain research is always on-going, it is also remaining constant because there are always questions concerning how we can challenge the brain to reach its maximum potential. Now, with knowing the students and the brain, we can continue with the research preparation, the research, and the eventual findings.

CHAPTER III

THE RESEARCH

Preparation

Preparing for this research was one of the most strenuous actions I have completed in a long time. But throughout all of the tough decisions, I knew one thing for certain: this had to be research where the students did not have any idea of the research taking place to reduce bias of behavior and progress. I wanted this to be the most authentically observed research that could be conducted because I decided not to focus on the numbers, but rather perception, retention, and attitude towards learning mathematics while listening to music in class. It was a continuous string of questioning actions and choices to facilitate the research without the students' knowledge about any of my work. This was just the beginning.

This line of questioning became a challenge when I had to prepare myself for the potential outcome of the students' performances with the effects of music not being ideal along with how I would handle it if the results that were not in the best interest of the student participating in the experiment. This did not become a complicated choice of

action. Understanding the possible negatives of the experiment was the first concept on my mind, because if the research only yielded negative outcomes, then my hypothesis would cease to exist. So, upon further consideration, I decided that I would remove the students from the stimulus if it had negative effects on them or distracted them from finishing assignments and assessments. This method of removing distracted students allowed for everyone to have an opportunity to achieve the best that they could with or without the resources made available. Creating a new layer to the research with the removal of the students helped address concerns of students with severe attention disorders and allowed the research to progress without interruption.

Along with the sifting method, it added the challenge of understanding all of the potential hardships of my students, like Caiden who is deaf or J.T. who has a learning disability based around attentiveness in class. This created a considerate environment at a more personal level of how I could potentially affect them beyond this experiment with them either accepting or rejecting the music for studying and facilitation. Where both Caiden and J.T. used music on a day-to-day basis, they have not had the choice of utilizing it in class where their focus is very important to their conceptual understanding of the taught material. I had to think of how I can compare their progress and growth with those students who are undiagnosed with any known disorders that affect their performance, which lead to the evaluation of all the students' performances prior to the musical addition of the instruction. A three-month period, or two nine weeks of the school year, with and without music seemed to be the most effective at drawing the line

of influence inside of the classroom, and this decision would have the most telling evidence of the truth behind musical influence on cognitive mindset.

Then with the tougher questions at an optimal level of care and understanding, I had to figure out how I would want to approach the students to maintain the secrecy within the experiment because children are aware of change and often ask why. I wanted to avoid them, potentially, asking me why for the sake of the research authenticity; so, I chose to approach this research at an ethnographic point of view by being a participant observer of the students. Providing the comfort of being the student teacher, the students had no suspicions of my work or choices in class that involved the music when I asked if they would mind if I played music during their independent work, group work, and assessments.

Months with No Music

For part one of the research, there had to be a control for known previous behavior and achievement of students. Prior to starting the experiment, I decided to go three months without any musical influence for all age groups and grades. This allowed for me to evaluate the students' academic strengths and willingness to accept outside stimuli outside of their own brains. Creating a contrast to when I would play music on a daily basis, the choice to go without music also gave me the opportunity to collect data from the students and faculty about how they utilize music, how often they use it, and if they believe it affects how they learn or perceive data.

Upon doing research by poll, questions and conversations, I was able to decipher what would be useful information in creating a productive, non-disruptive atmosphere for

learning with music. The majority of the people, with whom I held conversations, described the use of music as a normal part of the routine as waking up and brushing their teeth. There were a few that believed that music is made for leisure and could negatively affect learning for a significant percentage of students, but those students are the ones I highlighted with the sifting method of removing students who are not gaining any remarkable outcomes from the research. Also, the majority in the Facebook poll I created on January 25, 2019, voted that music affects cognitive ability out of one hundred and thirteen total votes at ninety-six percent. Then, we questioned if they believed it was a positive effect, negative effect or both which also leaned more on the positive side. Again, all of the conditions listed, such as attention, learning disabilities, and behavioral issues were brought up as potential blocking agents to the research fairness and treatment. This was not a problem because I had multiple plans to keep the research on track.

Through all the interviews in preparation to start the research, I began to use the month without music to start making assumptions of how to construct playlists of music that is to interest of the students and proven to yield positive results in cognitive studies. This was a complicated process, because I understood that it would be a consistent game of trial-and-error in order to find the most suitable arrangement that creates the optimal focus and thinking process for the students. I began with the obvious choice, classical music, but had to take into account that only musically inclined students would have been exposed and could find a genuine interest before the experiment if they participated in band (Jensen, 2008). Even though classical music was older than the generations of students I would be studying, it had tones and pitches that were indicative to a relaxing

experience, and it had the right idea of not including words into the music that is being played during the assigned times. Words in music can invoke deeper feelings and experiences that could hold more weight than just a melody in a student's mind. That concept of the invoking deeper emotions could be beneficial, but with more thought, I decided to leave the music as instrumentals with soothing beats, rhythms, and tones and some current piano instrumental covers of popular songs to alleviate any potential stress on the students. Other than tone and lyrics, rhythm became the defining factor of the music chosen by the end of the research, because rhythm is associated with movement, but not just the physical movement of the body but of the brain as well.

During the first three months, the students were adjusting to the school year, and I decided to evaluate their behaviors. At the elementary school, Alana and Chloe both had focus issues in regard to their math problems that were assigned to them during their individual work time. Their eyes would dart around the room at any noise and sound as if they were looking for something constant to keep their brains busy when they were expected to sit still and work individually, in groups, or test. They were the most expressive group of study subjects because children are thought to be honest and unfiltered with their thoughts and emotions, according to the elementary teachers, which made it even better when Alana looked at me during a test and told me, "I am bored. Do I have to do this?" and Chloe nodded her head in agreement along with a few more students within earshot. Others seemed tense in the silence even when they participated in group work where it would be assumed that they would be among their most talkative and loud in productivity. This tenseness was also a factor for the middle school students

and the high school students whom I chose to participate in the research, but they had a more concealed emotional pattern in the older age groups. Jordan and Caiden were among the most affected by the noiseless environment of the quiet three months. It seemed as if they were waiting on any noise to wake up them up. Also, the middle school students were more prone to asking questions to not only gain understanding for the concepts being taught, but also to extend their knowledge for future objectives in other math classes in high school. In the opposite direction, the high school students completely conceal their inner thoughts and ideas for the believed fear of judgement or rejection of opinions. Observing the high schoolers was the same as watching a prison documentary, like 60 Days In on A&E, in a sense because they acted as if they had to remain silent or act out in order for them to get their way. J.T. and Claire were those two polar opposites that I referred to about the choice of rigorous behavior patterns and passive behavior patterns respectively, and they represented the two main behavior models in the high school study subjects.

According to my journal entry on September, 7, 2019, I began examining J.T.'s behavior:

“

- J.T. comes into class very carefree, but slightly annoyed to be in math class.
- He is fairly sociable with Claire and Camryn.
- Does not want to do the bellwork or any assigned work. No homework either.
- He has plenty of attitude and has kept an attitude all week.

** teaching**

- During individual work, [we allowed them to listen to music if they had headphones] J.T. is demonstrating the complete opposite behavior of what he has been exhibiting for the past few days.
- He could be a great participant--he is feeling the music and moving. His head is down, but he is so aware. I wonder how he will react when I start the research.”

These observations from the beginning weeks of J.T. set the tone for the research because if I contribute to his use of music in class, then I can help extrinsically motivate the other students to become more intrinsically motivated about learning. Also, it was weird because the high school students and the elementary students had fairly similar behavioral traits like constantly moving, looking around, and giving attitude about working on any assignment. These comparisons and contrasts gave me an acceptable beginning variable until I started playing the music in the next three months, and I kept up with the varying behaviors by jotting down notes from my observations.

Do You Hear What I Hear

Now, for the second phase, it will be broken down month-by-month to thoroughly talk about the students’ behaviors and progress throughout the research process. In order to complete this study, I referenced Kolb’s “Experimental Learning” learning cycle, which includes: a concrete experience, a reflective observation, an abstract hypothesis, and active testing. In respect to the order of the learning cycle, my cycle began with my experience followed by a reflection of how it affected me, then formulating the

hypothesis that music affects learning, and finally testing the hypothesis on the students through the research. My experiences motivated me to conduct the research so I could motivate any or all students and create a sense of awareness of the benefits of music use in classrooms. Then, with awareness comes integration of the practice of music academically in their daily lives, and playing music would then would become a habitual action. There were a lot of little incidents that led to significant discoveries of student thought and behavioral differences over the prolonged period of time.

The First Month For the first month, I eased the music into the routine of the students' group work so it would be a little less noticeable by asking them if they minded if I played some music while they worked. No surprise, all said yes to the music because some students are vocal about their focal issues. Nevertheless, I played classical music in the background of their group work settings for the first month to digest what the students would do in the proclaimed Mozart Effect. The youngest students seemed to calm down, which was an overall reverse of the previous behavior of constantly moving, whispering and being off task. The classical music seemed to keep them busy because I hardly saw any unnecessary behavior within the group work, and that led to better behavioral reports and a slight increase in daily grades. Alana's behavior was to be expected with her enjoying the music and working more diligently, but Chloe stopped observing the room and began focusing on her work with the music playing in the background. It was almost as if she was trying to understand how the music was affecting her before I could even do that myself, and she seemed to relax. Relaxation became a common trait during the first month because there was no silence to take up all the space in the room, which created an

environment of comfort for each student to breathe and release some tension and nerves. The older students in the study, the middle and high school subjects, did show less-extreme behaviors while listening to the music, but it was short lived because of lack of interest. Jordan, Caiden, J.T., and Claire all responded well for the first 20 minutes of group work listening to the music, but then it progressed into them asking me to change the music and then loss of focus on the task at hand. The work in front of them became less of a nuisance and stressful as they listened to the music, but their mind quickly processed the music and decided that it was not acceptable for continuous work levels. Stopping the music and thinking about my next steps, I began to consider other musical choices, and then it became a question of what music I would play to get their attention, while at the same time keeping them on task to finish the classwork. My goal was to do this while observing them in both group and individual work at the end of the first month's data collection.

The Second Month Leading into the second month, I enlisted the assistance of a musical interest inventory to try to meet my more mature students halfway within the research, but in a way that they still had no knowledge of in order to have a better idea of which music they believe allows them to fully thrive, I knew I needed a solution to keep their attention focused on achieving their goals. It was a modification that I believe was necessary for the proper changes to take place naturally in the classroom without any predetermined obstacles. This became important as I started to play music during the students' individual work. Beginning with the students that were the most affected by the musical influence, the high school and middle school students decided that anything

Disney or pop culture current was appropriate for them to work more efficiently. They were correct to an extent, but I had to be careful with the recommendation and suggestions of choices of the students that were not appropriate for not only the class because of school policy, but also what was not appropriate for student thinking processes. After I created a playlist of melodies of Disney music and some of the most popular hits from the past decade, it was an improvement with the students' behavior and their academic achievement. The music became an incentive for the class because they appeared to acquire the mentality that if they were to be examples of solid work and self-control with the music, then they would be able to use the music whenever there is group work and individual work assigned in class. The music being played was a relief system for them, but this time, they had a choice about what type of music that was being used for the research. With this new-found attitude, the students' behavior did a complete one hundred and eighty degree turn similar to that of the younger students. Jordan, my most talkative of all the participants, was silent not out of frustration, but instead she was silent so she could focus on the music and work along with it. In addition, Caiden's, who was already attentive, grades were improving along with Claire and J.T.'s. Hannah became the darkhorse of the research, but quickly began to improve in her grades and behavior if the songs had her approval. This improvement from the older students and the steady improvement from the younger ones, whom I kept using the classical music for their facilitation, allowed me to pay more attention to those who were not receptive to the different music being played in class. There were students who appreciated the classical music, missed it, and preferred that it be played, while I was experiencing exponential

improvement with the new majority of students compared to the last month in accordance to the musical change. So, I had to make the decision to move the other students to another side of the room or to an empty class room so the different music could be played without disrupting the flow of the room, and everyone would be satisfied and working. Again, those small modifications to the classroom allowed the equitable opportunities to begin to show for all of the students to find success in the new method of instruction.

The Final Month During the final month of research, I was ready for the assessment portion of the research. This was the most important aspect of the research because it would depict the most compelling evidence of the music affecting the students' thought process when it is just them working to complete a task of importance, as opposed to classroom group and individual work. This allowed me to test retention of knowledge, behavior towards the work, and overall performance in the class from the first month to the last month of research. Allowing the research to be conducted over a longer period of time gave the students more time to build up the efficiency using the music as an advantage rather than a distraction from work, and it gave me the opportunity to have an accurate idea of how the music affected them without their knowledge, regardless if it was a negative or positive outcome. Prior to the music, the students were raucous, antsy, and unfocused on the mathematics, but as the music progressed over the first two months of research, the students' work began to evolve with the music. The music began to set the tone of the room and the behavior of the atmosphere for learning because the students began to depend on the music for their understanding and practice of mathematical concepts in class. There were some days where I did not play music to test

the reactions of the students, and the result was the reversion back to previous behaviors and actions of the students that were not as productive as the progressed state by the third and final month. The younger students showed great progress with their behavior, and many exhibited a deeper thought processes about math for them to be in elementary school. Some even advanced in their benchmark testing by almost ten percent across the entire class. Alana and Chloe were amongst the students who showed growth from the beginning of the school year to the end of the third nine weeks of school with attention, behavior, and academic achievement. Alana even began to show more improvement at home with common behaviors after school because she felt like her needs were being met at school, and she was happier to go to school every day, as well. Along with the elementary level students, the middle school students began to express more interest in coming to class and learning new material and concepts from day-to-day with less attitude and behavioral issues. In a similar fashion, the high school students gained a new commitment to learning mathematics and practicing in class, as well as, at home to gain a better understanding. The mathematical work of the majority of students progressively improved if it was not comparatively high to their previous scores or remained constant if the student was already high achieving academically. The last month of research defined and refined my hypothesis because the students provided unique perspectives of the music's effects without uttering a word for the duration of the my observations. Their movements created a dialogue for the evolution of their performance from the start to the end. Finalizing the end of my research, the data provided enough information to reach my final conclusion.

CHAPTER IV

THIS IS YOUR BRAIN ON MUSIC

This chapter will examine the brain while under the influence of music from different points of view, medias, and live feedback of observation of students within the research to provide validation to the assumptions I have created about the significant influences of music on cognitive mindset and learning capabilities.

According to Berkowitz's [science writer in Almonte, Ontario] article "How music affects the brain" (2014):

When Dr. Penfield [founder of the Neurological Institute and Hospital] published his landmark account of the functional localization of music in our brains, there was nary a psychologist or neuroscientist studying music and the mind. Now, after the recent 50th anniversary of Dr. Penfield's article, music in its myriad forms has emerged as a primary instrument for exploring our essential natures - no brain surgery needed. (p. 1)

This is a statement that does not need much explanation because it is a fact that people underestimated the use of any creative outlets, like music, and the effects of utilizing those outlets while studying brains' functional capacities. Studies of the brain show that music provides a unique window into the complex networks of our minds, and is "one of the few universal cultural traits, on a par with language, and most scientists think it's unique to Homo sapiens," (Berkowitz, 2014 p. 2) which means that music is as natural from state-to-state, country-to-country, and continent-to-continent as speaking in a native tongue (Berkowitz, 2014). Along with universal use of music, synchronization is also a skill that occurs in the brain with musical influences that make humans unique to any animal in the animal kingdom. This allows people to create silent movements of memorization with the rhythm of the music called entrainment. Entrainment is a creation of an internal rhythm that the brain uses to make a distinction of music being interpreted from external forces or influence that affects the motor areas of the brain with or without physical movement happening in real time. Speaking of entrainment creates discussion of the concept of the process of sensing, integrating, and acting in experimental learning studies. These studies led to more updated research strategies that involved neuroimaging which showed multiple participants' brains as they released the primary pleasure-related transmitter dopamine several moments before the climatic emotional crescendo of music they liked, which became a milestone in the cognitive neuroscience of music (Berkowitz, 2014). It revealed evidence of exercising of the brain while creating schema when different areas would light up with vibrance in the neuroimaging photos. There is also evidence that playing and listening to music can boost immune systems and reduce stress,

which has proven to be more beneficial than prescription drugs when dealing with patients with anxiety driven conditions, like an adolescent in school, with the secretion of dopamine and endorphins. Musical therapy is another psychological remedy used for more than just calming the brain, but rather to also rewire brains to overcome disability and brain damage with the most common studies being with patients that suffer from stroke and Parkinson's. This generated the idea that, regardless of the deterioration of the brain, music will always be a common piece that is left when everything else is gone from a person's functional capacity as a way to reteach illness-stricken people or to initially educate future students.

Berkowitz (2014) also stated in his article that:

Music gained an academic toehold with the cognitive psychology revolution. Rather than a behaviorist approach focused on only observable physical behaviours, cognitive psychologists studied the brain as mind, those experiences going on inside our heads that can't be directly observed, such as memory and feelings. It was a shift in perspective that profoundly changed the way psychologists saw music. (p. 3)

That is a prominent milestone in education because once psychologists began recognizing music as more than art, it opened the doors for further researching into the mind's receptiveness to music and its short- and long-term effects. The brain has four core brain principles:

1. All human processes are a function of the complex interplay of mind, emotions, body, and spirit.
2. The body-brain system is governed by a wide range of factors.
3. A genetic basis does not by itself explain the wide variety of human beings.
4. There is a host of factors known to influence brain function (Jensen, 2008, p. 10).

All of these principles point to the idea that the human brain is highly experience-dependent. In this case, music is the known experience that is being enriched, which is a positive biological response to a contrasting environment, in which measurable, synergistic, and global changes have occurred. This perspective of music in education became more unique as we refer to hearing disabled or impaired. According to Colucci (2014), “For hearing aid users, it’s easy to listen on a regular basis to music that familiar and comfortable, with and without vocals, even to sing along,” (p. 1) which becomes a rewarding way to help improve auditory and cognitive abilities. Also, music creates higher level cortical excitation, requiring information management that exercises the brain and eventually leads to learning. Through music’s complex spectral and temporal patterns and activities, it helps wire the brain and bind the senses and lack thereof.

Musical choice is a factor in how music affects the brain because “previous analysis indicated that specific genres affected the connectivity of the auditory cortex differently” (Wilkins, 2014, p. 3). Following a study that used whole songs opposed to

snippet clips of music, the findings of preference over randomness became more illustrious with changing generations and the addition of public opinions of productive musical choices. With preferred musical choices, the network connectivity of the brain highlighted and implicated in engaging divergent thinking and creative activities increased brain functions in learning.

Now, with music being involved with education, it is important to understand how music has improved mathematics education in schools. In one program for inclusion for music in school called, “Academic Music,” a hands-on curriculum uses musical notation, clapping, drumming, and chanting to introduce third grade students to fractions. The program studies one of the most complicated mathematical concepts in elementary curriculum to truly test the authenticity of the program’s success because if students do not understand fractions and partials early, then they struggle with algebra and mathematical reasoning later on in educational instruction. It was a study that made students equate musical notes to fraction sizes, and by clapping and chanting, the students learned the time value of the musical notes also to learn fraction sizes. It provided lower achieving students the ability to find a method to learn and eventually lead to the students passing the final test similar to their high achieving peers. Showing not only academic success, it also promoted better communication skills which lead to better behavior and enthusiasm to learn mathematics (Music, 2012).

With all the information provided, the brain can benefit from music. It creates a fluid network of pathways through the brain that unlocks a new kind of knowledge regardless if the person is or is not musically inclined. There is evidence that proves that

music education could have a correlation to high test scores because it is shown that music's value, from an evolutionary perspective, revolves around its ability to help people cope with cognitive dissonance, that intense feeling of discomfort when someone encounters information that contradicts a core belief (Jacobs, 2013). This means that if the students are not comfortable with a subject, they will turn to music in order to calm feelings and emotional distress. On the other hand, *The Musical Brain* acknowledged the idea that anyone can do well using music without having to know how to play music. There were musical geniuses and artists examined like Sting, Wyclef Jean, and Michael Buble, but there were also normal non-musical people being examined to show that music can affect the brain of anyone while emphasizing the brain's movements. Music on the brain shapes the human experience through the manifestation in the brain within each stage of life (Pochmursky, 2009).

This is your brain on music. I named this chapter with the idea of music acting as a drug because the effect of music on the brain does not differ from the concept of drugs also affecting the brain. They both create a form of dopamine within the brain, highlight a unique networks or thought processes, ultimately affecting the overall function. The brain on music is a brain worth studying. It has unlocked a door of education that is unmatched and always developing in the progress of student learning.

CONCLUSION

Reaching the end of the research revealed the most information about how the music affected the students. Where some students rose to the occasion of utilizing the music for motivation to persevere and succeed, there were also those students who could not find the relaxing tones to settle their mind in order to work effectively and efficiently. I observed that when I chose not to play music, the students who started to work along the beats and melody would ask me if I would play it during their classwork and assessments, even when I stopped my research. This made me recall this quote, “sound is a natural vehicle for learning,” and it was almost as if the music became an incentive for them throughout the week when I stopped playing it to better determine my conclusion of the research. Music creates a dynamic learning experience. As said in the *The Art of Changing the Brain*, “... learning is change. It is a change in ourselves, because it is a change in the brain” (Zull, 2002, p. xiv). Learning is not a fixed idea in the world, and neither is teaching, because every student is different which means every student also learns differently. I believe music bridges the gap of achievement in the classroom because it allows more of the brain to be utilized at its apex potential. It is the teacher’s job to create a learning environment that invites favorable conditions that lead to change

in a learner's brain so we can rewire the mind for a more brain nurturing environment for to show creative skill develop in relation to mathematics education. My intervention in my classroom with the addition of music into the daily routine changed my students' outlooks on learning and how they actually learn inside and outside of the classroom. It gave an outlet through rhythm and sound that could not be taught by word of mouth and created a new atmosphere for the learning process. Behavioral issues were at an almost daily occurrence at the beginning of the research, but at the end there were virtually none with the music. Then, with the behavioral issues and attitude improvement, the students' grades followed quickly behind which motivated them to continue to keep their grades on the incline. Overall, I believe music has and always will have a place in a classroom and learning process because "one of the most important points about experimental learning is that it engages all of our senses" (p. 137). Not one or the other, but all of the senses of every student are important for learning. So, music is the zestful modification of a productive and equitable classroom.

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